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Pseudorabies Eradication-Did We Look Before We Leaped?

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Introduction

Pseudorabies, or Aujeszky's Disease, is currently one of the biggest concerns of the livestock industry. The disease has been in the United States since the mid 1800's¹ and its first report in literature was by Aujeszky in 1902.² Prevalence of the disease in swine has risen dramatically in the U.S. from less than 1% in 1974 to greater than 10% now.³ This dramatic increase in prevalence has caused the livestock industry to look closely at the disease and ways to eradicate it. Several pilot projects were initiated to assess the feasibility of eradication. Given this initial data, the Livestock Conservation Institute (LCI), National Pork Producer Council, state and federal authorities, and other organizations have developed a national pseudorabies eradication plan and the LCI has set the goal of achieving pseudorabies-free status of all states by the year 2000.⁴

The Disease

Pseudorabies is caused by a member of the Herpesvirus group. The pseudorabies virus (PRV) multiplies in a wide variety of mammalian and avian cell cultures. PRV is readily killed by sodium hypochlorite, phenol, formaldehyde, heat and ultraviolet irradiation.

Most herpes viruses are limited to a single species. However, PRV has a very broad range of species that it affects, which makes its eradication even more difficult. Swine are relatively resistant to pseudorabies, which makes this species an excellent host and reservoir for this disease. Cattle, sheep, dogs, cats, and mice are quite susceptible to the disease and therefore die rapidly after being infected.

The major mode of spread is via nose to

nose contact and aerosol. Contamination of feed, water, bedding, walls, fencing, and floors also provides a way for pigs to contract the disease. Vectors such as veterinarians, livestock trucks, feed delivery trucks, rendering plant trucks, and people traffic⁵ play a very important role in the spread of PRV. Other means of spread have been implicated, including embryo transfer, wild animals, and birds.⁵ Factors such as herd size, virulence of the virus strain, and general health status⁶ of the herd are also very important considerations in the spread of this disease.

Swine are the principle reservoir of PRV. Horizontal and vertical spread of infection occurs. The virus has been shown to have chronic persistence and latent persistence. Research by Schoenbaum, Beran, and Murphy showed that immunosuppression by dexamethasone caused a recrudescence of the latent virus.⁷ Thus, any stress to the pig such as mingling, movement, or environmental conditions can cause the latent virus to become active and be shed. This latency is an important complicating factor in the epidemiology of this disease.

The characteristic signs of infection in animals and birds are excessive salivation, fever, depression, and convulsions.² Animals other than swine affected by the disease may show a severe pruritis, leading to the name "mad itch" by which this disease is sometimes called.

Infection in pigs may range from subclinical to death. Severity of disease depends on virulence, dose of exposure, age of pig infected, and immunity level present.¹ The greatest mortality in swine due to PRV occurs in suckling pigs. Signs in these young pigs include dyspnea, fever, hypersalivation, anorexia, vomiting, diarrhea, trembling, depression, ataxia, nystagmus, running fits, intermittent convulsions, coma, and death.²

Weanling and fattening pigs may have a fever of 105-107°F and may show sneezing and/or a persistent cough. Occasionally, the pigs may show signs of neuropathy such as tremors, incoordination, convulsions, paddling, and death. Secondary bacterial infections are common.

Infection of pregnant swine results in

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resorbed embryos if infection occurs prior to 30 days of gestation. Sows infected later may abort or give birth to macerated fetuses, stillborn or weak infected pigs. Pigs born to sows with antibodies to PRV will be protected by maternal antibody via milk until about four weeks of age. Antibody levels decline rapidly after this time and pigs may become infected and show clinical signs or be carriers.

Why Eradicate?

Many people have asked the question, "Why should we eradicate pseudorabies?" Extensive research and personal experience have been used to try to answer this question. Numerous studies have been done to evaluate the monetary costs of the disease and its eradication. Some of these examples will be presented later in this paper.

Most of the loss to the producer is due to the loss of pigs during an acute outbreak. However, there are many undocumented costs that are incurred besides the losses due to an acute outbreak. These include:

1. Lowered production efficiency due to subclinical, chronic, or low grade clinical infections and/or synergistic effects of pseudorabies virus with other infections.
2. Death losses in cattle and sheep.
3. Death losses in infected dogs, cats, and wild animals.
4. Sales and marketing losses incurred by seedstock and feeder pig producers due to restrictions on movement and change of ownership.
5. Losses in export markets for live swine and pork.
6. Loss in producer satisfaction due to increased risk in production that results from the presence of pseudorabies.⁸

Eradication of pseudorabies would be a benefit to society and the pork industry. Society would benefit by being able to get pork at a lower price since producers would be able to produce pork more efficiently. The pork industry would also benefit by producing pork more efficiently, thereby being able to compete better with poultry and other meat products.^{9,10}

Costs of the Disease

When an outbreak of pseudorabies occurs,

losses to the producer may range from almost nothing to financial disaster. Losses incurred are due to abortions, embryo resorptions, stillbirth/mummies, and death in suckling pigs, grower/finishers, and breeders. Also, there may be a reduction in breeding efficiency, growth performance, and value of breeding stock.⁹ In order to get an idea of the actual cost to the producer, several researchers have tried to evaluate data from infected farms. The NPPC and APHIS organized five pilot projects to document costs of pseudorabies to producers, and estimate the public costs of eradication.^{9,10} These pilot projects were Pike and Macoupin Counties in Illinois, Marshall County, Iowa, and statewide programs in North Carolina, Pennsylvania, and Wisconsin. Examples of some of the outbreak costs studies are as follows:

1. Hoblet, Miller, and Bartter¹¹ used farm production data to assess the costs incurred in a 150 sow herd with a clinical outbreak of pseudorabies in 1983. The total loss in this relatively small swine herd over a nine month period was \$48,175.
2. Kliebenstein, Patterson, Moore, and Thawley³ estimated losses for a 1000 sow operation using records from a large swine production firm. The loss was estimated at \$11,023.65 or \$16.21 per sow farrowed during the 17 week outbreak period.
3. Alderink⁹ stated that Jorgensen had reported a herd in Denmark sustaining losses of \$145/sow during an outbreak. He also reported that, according to Vargas Levara, five herds in Minnesota had an average loss of \$87.92/sow. Pennsylvania producers have reported losses of \$12,352 per 120 sow herd or \$103/sow. Using a computer simulated model, Illinois producers were estimated to lose \$138/sow due to a PRV outbreak.
4. Arne Hallam¹² did an economic analysis of preliminary data from the Marshall County, Iowa project and found that the average cost of controlling a clinical outbreak was \$400.15 per 111 sow herd.
5. Hallam, Zimmerman, and Beran⁸ reported that PRV was costing \$9,048,049 for clinical outbreaks, \$1,889,510 for serology, and \$10,310,258 for a total annual cost to the U.S. swine industry of \$21,247,862.

Although various methods are utilized in analyzing economic losses due to PRV, it is clear that a PRV outbreak can cost significant economic hardship.

Methods of Eradication

When a diagnosis of pseudorabies is made, the LCI¹³ currently recommends using one of three methods to eliminate the disease from the operation. These methods are test and removal, offspring segregation, or depopulation/repopulation.

Test and removal may be least disruptive to management as well as being least costly. Immediate test and removal (with or without vaccination) is used when less than 20-25% of the breeding herd is seropositive and there is no evidence of infection in growing or finishing pens. The entire herd is tested every 30 days and all positive animals are immediately removed to slaughter or a quarantined feedlot. Remaining animals may be vaccinated with a differentiable vaccine. If, after three tests, seropositive animals continue to be found, this method should be reevaluated. After two whole-herd negative tests, the herd may be considered free of pseudorabies.

Phased test and removal with vaccination is used to minimize the interruption to pig flow and financial costs. All sows and boars are tested and then vaccinated with a differentiable vaccine. The positive sows are removed at their next weaning and are replaced with vaccinated gilts. All positive boars are immediately removed from the herd.

Offspring segregation is most applicable when at least six months have elapsed since a clinical outbreak or in herds with only subclinical infections. Initially, all open sows and gilts are vaccinated. These animals are then revaccinated two to four weeks before farrowing. Baby pigs are weaned early (at 2-3 weeks) and gilts are moved to an isolated facility. These gilts are randomly tested at four to five months of age. If any animals are positive, the entire group must be tested. If less than 10% are seropositive, the positives are removed and all the gilts are retested at 30 days. If more than 10% are positive, the entire group must be sold and the process started over. Negative gilts should be put only in clean areas and there should be at least a 30 day open-space between progeny of old infected animals and progeny of the negative gilts. The new herd should be monitored every three months and is considered to be of PRV free status when two tests of 14 breeders and 9 finishers are negative.

Depopulation/repopulation is the plan that is most likely to succeed. It is recommended for use in herds with a high percentage of seropositives (>75%), existing genetics of little

value, multiple health problems, and confinement housing or housing where separation is difficult to maintain. Hogs may be sold at market weight to slaughter or sows sold to slaughter and pigs moved to a quarantined or separate feedlot. The entire premises is cleaned thoroughly and left depopulated for a minimum of 30 days. Pseudorabies negative swine are brought onto the farm and are retested 30 days later.

Thawley, Beran, Hogg, Gustafson, and Vinson¹⁴ evaluated these three methods of eradication using data from the five pilot projects. Slaughter sampling was performed in North Carolina, Pennsylvania, and Wisconsin and on-farm testing was done in Iowa and Illinois. Once a positive herd was found, a herd clean-up plan was developed. A total of 253 infected herds were identified. Of the 119 infected herds involved in a clean-up program at least 18 months before September 30, 1986, 116 (97.5%) had been recertified by that date. One hundred thirty-four herds were identified as infected later than the previous herds and many had not had enough time to clean up by September 30, 1986. Test and removal was effective in 47 herds. Offspring segregation was successful in 30 of 31 herds. Depopulation/repopulation was successful in 102 breeding herds and 28 feeder pig finishing farms. The authors of this paper concluded that the elimination of PRV from individual herds is feasible.

Costs of Eradication to Producers and Society

The cost to eradicate pseudorabies involves many things. Included are veterinary services, vaccine, testing and tagging, cleaning and disinfecting, isolation and segregation facilities, transportation, downtime, losses of culled breeders, and added labor. In an eradication program these costs are shared by the producers and the taxpayers of the United States through state and federal sponsored programs (see Table 1).

Conclusion

After a considerable amount of preliminary research and discussion, the National Pseudorabies Eradication Program was initiated on February 1, 1989 in the form of the "State-Federal Industry Program Standards for Pseudorabies Eradication"¹⁶. A table containing the responsibilities of various state and federal

Table 1. Methods of Eradication

	Depopulation- Repopulation		Test and Removal	Vaccination w/ Offspring Segregation
	Feeder pig finisher	Farrow to finish	Farrow to finish	Farrow to finish
Producer cost	\$ 0.30 ^a	\$ 145.93 ^b	\$ 0.98 ^b	\$ 28.78 ^b
Program cost	0.09	57.73	6.80	12.09
Total cost	0.39	203.66	7.78	40.87

^acost per pig marketed

^bcost per sow

organizations can be found in the *Proceedings of the Annual Meeting of the Livestock Conservation Institute*, 1990.

The program is moving along well in states that have very small populations of swine. In Iowa, where swine numbers are very high, progress in the program is moving more slowly. This is due to the fact that whole state slaughter surveillance and traceback is extremely difficult due to lack of manpower and density of livestock. Also, some feel that a whole state surveillance program would put many producers out of business. Therefore, Iowa is using a slower county by county on farm testing procedure to clean up the disease. Surrounding states such as Minnesota don't feel Iowa is moving fast enough. Undoubtedly, the logistics and politics of pseudorabies eradication will be a hot topic for the next few years.

As the program moves along, much experience will be gained and eradication efforts will move along even faster. Issues are continually being addressed that will assist in the cleanup effort. One of these is the presence of pseudorabies in feral swine. Guidelines for herds exposed to feral swine are proposed. Oral vaccines for feral swine have shown some promise. Research is also being done to determine if serological tests give a true picture of the disease within a herd. The effect of intensive vaccination on stopping waves of low grade infections in an area is also being looked at. Methods to eliminate pseudorabies from very large herds have been proposed. From these examples it is apparent

that much effort is being put into finding possible pitfalls in the eradication of this disease.

If the estimates are correct, the cost of eradication should be recovered in ten years. Many people feel that this program is indeed feasible, both technically and economically. Even though the pilot study data did show that eradication is feasible, ongoing cost/benefit studies continue. Dr. Frank Mulhern⁴ said, "... I firmly believe that these studies need to continue to evaluate the economic conclusion mainly reached during the pilot studies." This attitude will undoubtedly lead to further economic investigation.

Extensive research was conducted to determine whether the eradication of pseudorabies was indeed possible. The people involved in the swine industry felt that this preliminary research was enough to initiate the program. Without a doubt, many snags in logistics, politics, epidemiology, and economics will make the eradication a challenge. The industry appears up to the challenge.

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